

Implementation of a modified obstetric early warning system to improve the quality of obstetric care in Zimbabwe

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1 **Improving the quality of obstetric care in Zimbabwe through**
2 **implementation of a modified obstetric early warning system (MOEWS).**

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20

21 **Keywords:** Recognition of deteriorating patients, Maternal Health, Low-
22 resource settings, Decision support tools, Early Warning Scores.

23 **Word Count:** 2815

24 **Type of Article:** Clinical Article

25

26 **Abstract**

27 **Objective:** To implement the Modified Obstetric Early Warning
28 System(MOEWS) to promote identification and stabilization of unwell women.

29

30 **Methods:** This before and after study of MOEWS implementation took place
31 between April 2013 and January 2014, in a Government referral hospital in
32 Zimbabwe. After piloting MOEWS, caesarean section case files were
33 retrospectively assessed to ascertain pre-operative stabilization. A
34 longitudinal 'spot-check' study, measured the use of MOEWS and action
35 taken on abnormal results. A quality indicator was introduced to assess
36 ongoing implementation. Results were analyzed using chi-squared and
37 logistic regression techniques.

38

39 **Results:** The caesarean section study included 78 women before and 80 after
40 MOEWS implementation. There was a significant improvement in pre-
41 operative stabilization post-intervention(OR 2.78 95% CI 1.39, 5.54). The
42 longitudinal study included 43 women at baseline and 85 post-
43 implementation. A significant improvement was recorded in action taken after
44 MOEWS (1/24(4.17%) vs 28/45(60%) p=0.001). The six-month aggregated
45 quality indicator revealed 78/125(62%) completed MOEWS, with appropriate
46 stabilization in 65/70(92.86%).

47

48 **Conclusions:** Implementation of MOEWS improved women's care through
49 action being taken on abnormal observations. Before whole-scale adoption of

50 MOEWS in low resource settings, this study should be scaled up and

51 repeated to ensure replicable findings.

52

53 **Synopsis**

54 Implementation of a modified obstetric early warning system in Zimbabwe

55 improved action on abnormal observations. This simple system can empower

56 staff and improve care.

57

58 **Introduction**

59

60 Quality of care is gaining increasing attention globally as policymakers,
61 managers and clinicians acknowledge that improved care can lead to better
62 outcomes for patients. During the Millennium Development Goals campaign
63 there was a 47% decline in the number of maternal deaths worldwide, [1]
64 however this is far short of the 75% decrease which was set as the target for
65 2015. In trying to meet this goal, several countries in sub-Saharan Africa
66 introduced policies of removing user-fees for maternity services and,
67 unsurprisingly, this has increased demand for care.[2]

68

69 In Zimbabwe, maternity services were made free in 2012. This has resulted in
70 increased demand and therefore staff are under more pressure. In this
71 environment, simple decision support tools can help staff to identify and then
72 prioritize unwell patients.

73

74 Tools such as Early Warning Scores (EWS) were developed in order to
75 facilitate the timely presence of appropriately skilled staff to attend clinically
76 deteriorating patients.[3] They provide the opportunity to aggregate the impact
77 of sometimes subtle deterioration in physiological observations into an overall
78 score which, when abnormal, is used to prompt a clinical response.[4] Many
79 different EWS systems exist. A recent review of their impact has suggested
80 that there is a trend towards improved patient outcomes with their use.[4]
81 However, the unique physiology of pregnant women is not accounted for in
82 the EWS designed for the general population, and it does not effectively

83 identify at risk patients.[5] Modified Obstetric Early Warning Systems
84 (MOEWS) have been widely used in the United Kingdom since they were
85 recommended by the National Confidential Enquiry into Maternal Deaths in
86 2007.[6] A tool based on similar principals a 'Maternal Early Warning Trigger'
87 has recently been evaluated in the United States, and has shown a reduction
88 in maternal morbidity. [7] These tools have not been widely used or evaluated
89 in resource poor settings.

90

91 The MOEWS charts advocated for in the 2007 Confidential Enquiry[6] are a
92 simplified EWS, using a color coded method of red and amber scores, rather
93 than a numerical system. If one physiological observation falls into the 'red'
94 section of the chart (significantly abnormal) or if two observations are in the
95 'amber' area (slightly abnormal), a clinical review is required. This system is
96 less complicated than some of the other maternal trigger systems that have
97 been developed, [7-9] and therefore was selected for this study as the most
98 suitable tool for introduction in this low-resource, high pressure setting.

99

100 In 2011 a health-partnership between the Zimbabwean referral hospital and a
101 UK teaching hospital was initiated. As part of this partnership PRactical
102 Obstetric Multi-Professional Training (PROMPT) was initiated, and is ongoing.
103 Alongside this, the Zimbabwean hospital began monitoring their outcomes
104 using a maternity dashboard.[10] On a background of commitment to quality
105 improvement, we designed this study to develop and implement a locally
106 applicable MOEWS to see if patients could be better stabilized before transfer

107 to theatre and if more timely action could be taken when patients began to
108 deteriorate.

109

110 **Materials and Methods**

111 MOEWS was adapted to and piloted in a Zimbabwean Government funded
112 referral hospital. This hospital had a dedicated maternity unit with
113 approximately 10,000 deliveries per year and a caesarian section rate of
114 approximately 18%. The implementation of the adapted MOEWS was
115 evaluated in three ways. Firstly, an observational before and after study of
116 whether women were appropriately stabilized prior to transfer to theatre for
117 caesarean section. The second part was a longitudinal 'spot-check' audit of
118 use of MOEWS charts on the wards. Finally, there was the development of a
119 quality indicator for ongoing monitoring of MOEWS use. This study took place
120 between April 2013 and January 2014. All members of maternity staff had the
121 opportunity to be included in the piloting process and department wide
122 implementation was undertaken.

123

124 The first stage of the study, which took place in April 2013, was the adaption
125 and implementation of the MOEWS chart. The Zimbabwean implementation
126 team, made up of PROMPT faculty members, was given examples of
127 MOEWS from the UK. These examples were provided in color and a variety of
128 black and white designs. The team selected the color version and then
129 adapted the MOEWS to make it relevant to their local setting, and identified a
130 local printer. The proposed MOEWS chart was taken to a meeting of the

131 senior nursing staff who agreed on the content of the MOEWS charts and the
132 implementation plan.

133

134 A piloting phase allowed all members of staff working in the unit to input into
135 the final version of the charts. Initially charts were given to staff on the wards
136 for their feedback. Then draft charts were then placed on the wards for staff to
137 use, with short introductions to the charts given to the staff by the
138 implementation team. To facilitate the pilot stage, questionnaires were
139 administered to all available staff on the wards. The questionnaires explored
140 whether the staff knew what MOEWS were and where to find them. It also
141 asked if they found them useful and if the trigger system facilitated the review
142 of patients, there was the opportunity for free text feedback and further
143 comments. Once further adaptations had been made, the Zimbabwean
144 implementation team planned a launch event. They also designed a MOEWS
145 training session to be delivered during the regular PROMPT training course in
146 order to ensure all staff were familiar with how to use the MOEWS.

147

148 Although the implementation team was composed of PROMPT faculty
149 members, the intervention was a new addition to PROMPT. PROMPT had
150 been used by the hospital as a method to deliver onsite annually updated
151 training to staff since 2011. Due to its regular place in the hospital calendar,
152 and the fact that all staff were released to attend training annually [10], using
153 PROMPT as a way to train staff in MOEWS was considered practical by the
154 MOEWS implementation team.

155

156 In order to measure any immediate change in practice following
157 implementation of the MOEWS charts, the quasi-experimental before and
158 after study was undertaken. This examined the effect of MOEWS on the
159 patients transferred to theatre for a caesarean section. In particular we
160 examined whether they were appropriately stabilized prior to transfer. Notes
161 were retrospectively reviewed at baseline (January-March 2013), and at 6
162 months post intervention (October-November 2013). A convenience sample of
163 patient notes was used due to resource constraints. For practical reasons,
164 notes were retrieved by hand from the administrative office and scanned until
165 patients who had a caesarean section were identified. Data was extracted
166 onto a proforma by AM and BTM and entered into Microsoft Excel. Descriptive
167 statistics, Chi-Square tests and logistic regression techniques were used to
168 understand whether pre-operative stabilization of patients occurred more
169 frequently after MOEWS implementation.

170

171 The second part of the study was the 'spot-check' audit, designed to enable
172 quick monitoring of whether ward patients had observation charts, whether
173 the observations 'trigger' an action according to the MOEWS chart, and
174 whether there was timely action on abnormal observations. Action was
175 considered to be taken if the member of clinical staff providing care
176 documented an action in response to the abnormal observation. This audit
177 was planned for baseline and then on a monthly basis for 6 months. Data was
178 collected on a simple form and entered into Microsoft Excel. Descriptive
179 statistics were calculated to understand the number of women with
180 observation charts, the number with observations that trigger action and the

181 number of women with action taken across the months. Chi squared tests
182 were used to compare the baseline group to post-implementation groups in
183 the follow-up period.

184

185 Following the initial observational study, the implementation team wanted to
186 look at the longevity of the changes, and embed ongoing evaluation of the
187 intervention. Therefore the third part of this evaluation, a quality indicator was
188 developed in order to provide the team with a simple way to monitor the use
189 of the MOEWS and any ongoing change in practice. This indicator was
190 measured on a monthly basis from August 2014 until January 2015, by the
191 MOEWS implementation team. It was carried out when a team member was
192 able to complete the audit (taking into consideration their clinical workload)
193 and incorporated the notes of the patients on the ward on that day.

194

195 The quality indicator captured the usage rate of charts (Number of cases with
196 correctly completed MOEWS charts/Number of cases reviewed), whether
197 healthcare staff took appropriate action to abnormal observations (Number of
198 cases in which action was taken/Total number of charts requiring action) and
199 the timeliness of the action if it is required (Total number where action was
200 taken within the required timeframe/Total number where action was taken).

201 Simple descriptive statistics were used to allow the implementation team to
202 assess ongoing use of the MOEWS.

203

204 All analyses were completed using Stata Version 13 (StataCorp, College
205 Station, Texas, 2013).

206

207 This improvement initiative was approved by the Mpilo Central Hospital
208 Management and as such no ethical approval was sought. As the intervention
209 was a department wide change initiative, no individual consent was obtained.

210

211 **Results**

212 MOEWS was adapted in April 2013 by the MOEWS implementation team,
213 then a team of senior midwives at the hospital made further changes and
214 approved the pilot chart. Changes from the UK example MOEWS included
215 that they would be used for antenatal admissions, high risk, high dependency
216 and post-theatre patients only, due to resource constraints. There was a
217 decision to add 'edema' to the chart as a possible predictor of pre-eclampsia
218 as urinalysis sticks are not reliably available to measure proteinuria. There
219 was also an alteration of the 'amber' levels on the blood pressures to bring it
220 in line with Zimbabwean guidelines. After a discussion about the ability to
221 measure oxygen saturations, the team decided it should remain on the charts
222 but they were aware that it was a measure that would not be recorded outside
223 theatre due to lack of appropriate equipment. They also introduced box for
224 staff to complete following action on abnormal observations.

225

226 A short pilot of the charts was undertaken and feedback on the charts was
227 collected and the overall results of the questionnaires staff completed are
228 displayed in table 1. Reasons midwives found the chart useful included: "most
229 information compressed and easy to evaluate at a glance" and "they alert the
230 nurse and alerts us on when to tell the doctor". The midwives on the ward felt

231 a space to record fetal heart rate should be added. Another issue raised by
232 midwives during this early piloting phase was the need for training “Midwives,
233 doctors and students in the maternity department could be taught on charting
234 as some errors are made leading to wrong scoring e.g. recording a systolic
235 BP and diastolic BP in the same column”. The doctors found that it was useful
236 to have the “ability to follow a patient in time”. They found the charts “... easy
237 to correlate with the clinical picture” and that abnormal observations are
238 “...usually an indicator that action has to be taken or patient has to be
239 monitored closely”. Like the midwives they felt that “it is a good monitoring tool
240 if properly followed” and that “everybody should have training in the MOEWS
241 chart”. The changes suggested from the feedback were made at a final
242 MOEWS produced for rollout (Supplementary Material S1).

243

244 The caesarean section theatre transfer study included 78 women in the before
245 and 80 after implementation. There was no difference in the age of the
246 patients in each group ($p=0.195$). There was a significant increase in the
247 proportions of patient’s undergoing pre-operative stabilization after the
248 intervention was introduced ($18/79(22.78\%)$ vs $37/85(43.53\%)$ $p=0.005$). Even
249 after controlling for patient age, participants in the post-intervention group
250 were more likely to be stabilized prior to caesarean section (OR 2.78 95% CI
251 1.39, 5.54). There was no difference in operation type, anesthesia delivered,
252 or estimated blood loss (EBL) or complication rates from caesarean section
253 between the two groups ($P>0.050$). Demographic and comparison data for the
254 operating obstetricians were not available.

255

256 In the longitudinal study, there were 43 women in the baseline group and 85
257 included in the follow-up period. Figure 1 shows the change in action recorded
258 following the implementation of the MEOWS chart. Before the intervention
259 there were no formal observation charts and observations were written
260 directly into the notes. After the intervention, 78/85(91.76%) of patients had
261 MOEWS charts in their notes and 64/85(75.29%) of the charts were used
262 appropriately. When dichotomizing the patients into groups before or after the
263 intervention, there was no difference in the number of women who triggered
264 the MOEWS score ($p=0.252$), however there was an increase in the
265 proportion of women that had recorded action taken after implementation
266 1/24(4.17%) vs 28/45(60%) $p=0.001$.

267

268 The quality indicator tool, designed to measure ongoing change in practice,
269 revealed that in the six month period of its initial use, 78/125(62%) had
270 completed MOEWS charts. Of these patients action was taken in response to
271 65/70(92.86%) of patients triggering on the MOEWS chart. All of these
272 patients received a clinical action within the recommended time frame.

273

274 **Discussion**

275 This implementation study has shown that through a partnership approach it
276 is possible to implement a decision support tool in a Zimbabwean hospital,
277 which can aid with the recognition of unwell patients and action being taken to
278 halt their deterioration.

279

280 The success of this study undoubtedly relied on the fact that the adaption of
281 the MOEWS and the implementation plan were led entirely by the
282 Zimbabwean team. However, a limitation may be that the exact figures
283 selected as cut offs in the chart, were not evidence based.

284

285 A further strength is that the Zimbabwean team played an active part in the
286 ongoing monitoring of the implementation of MOEWS and are continuing to
287 do this. However, the utility of this quality indicator may be reduced because it
288 does not incorporate all of the patients on the ward on the day of
289 measurement, rather a brief snapshot. It is however a pragmatic indicator,
290 which allows the implementation team to quickly assess the ongoing use of
291 the MOEWS.

292

293 The fact that this improvement project was undertaken in partnership has
294 allowed knowledge and skills to be transferred between the UK and
295 Zimbabwe team. This includes the fact that some of the Zimbabwean
296 suggestions for the MOEWS charts (e.g. addition of an action taken box) are
297 also being considered by the clinical team in the UK.

298

299 The training to use the MOEWS charts was embedded within the ongoing
300 obstetric emergency training programme 'PROMPT'. This does mean that
301 MOEWS as a stand-alone initiative has not been investigated in this study.
302 This may bias the findings in this study because the PROMPT training
303 ensured that there were enthusiastic champions to take the initiative forwards
304 and also meant that there was an approved and well attended forum for

305 providing the required local training to the maternity team. However, the
306 training was a stand alone element of the programme and therefore could
307 feasibly be delivered without the remainder of the PROMPT intervention.

308

309 The implementation of MOEWS was carried out at low cost, which makes it a
310 feasible intervention to consider implementing more widely. The main cost of
311 implementing the MOEWS is the printing of the charts, which as it was
312 arranged locally, in bulk and therefore relatively inexpensive at approximately
313 0.04 USD per chart. However, even this small cost is likely to be difficult to
314 meet in the poorest settings.

315

316 As was found in the UK [11] the midwives did not want to use the MOEWS for
317 every patient, but instead because of limited resources (utilization of charts as
318 well as time) wanted to use them on a selected group of patients. This limits
319 the potential of the MOEWS to be a safety net to identify the 'normal' women
320 who begin to develop complications. This may be the reason that the
321 simplistic quality indicator performed so poorly with respect to the completion
322 of charts post intervention as some of the patients in the study may not have
323 met the basic requirements to be allocated a MOEWS chart.

324

325 A further limitation is that this pilot was undertaken on one maternity ward.
326 However, it was in a government hospital with 10,000 deliveries per year. If it
327 is possible to implement the charts at a busy unit like this, it may well be
328 possible to implement the charts at other units where there are dedicated
329 maternity staff and a high throughput of patients. Due to time and resource

330 constraints we were unable to investigate whether it is feasible and useful at
331 smaller centers, where there are no dedicated maternity staff.

332

333 There is a lack of high-quality evidence relating to the MEOWS. The UK
334 version has been shown to be a useful bedside predictor of maternal
335 morbidity,[12] however as of yet this tool has not been validated in a low-
336 resource setting. Therefore, before whole-scale adoption of this decision
337 support tool in low resource settings, this adapted MOEWS should be
338 validated and this study should be scaled up and repeated to ensure
339 replicable findings in other settings.

340

341 **Conflict of Interest**

342 AM, JC and TS are members/trustees of the PROMPT Maternity Foundation,
343 they have no financial interest in the association. The remaining authors have
344 no conflict of interest to declare.

345

346 **Authors Contribution**

347 JC conceived the implementation project. AM, BTM, SMO, TS, JC designed
348 the study. AM, BTM collected the data. AM and SMe analyzed the data. AM
349 wrote the first draft of the paper and all authors critically revised the draft.

350

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354

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398 1

399

400

401

402

403 Table 1: Feedback from Midwives and Doctors during the pilot phase.




MOEWS chart:	Midwives(n=15)	Doctors(n=9)
Knowledge of	13(87%)	8(89%)
Location of	14(93%)	7(78%)
Useful	13(87%)	9(100%)
Receive/provide advice/review following trigger	3(20%) always 12(80%) sometimes	4(44%) always 5(56%) sometimes
Suggested improvements	6(40%)	4(44%)

404

405

406 Supplementary material S1: Modified Obstetric Early Warning System

407 (MOEWS) Chart

MPIO CENTRAL HOSPITAL MODIFIED OBSTETRIC EARLY WARNING CHART

(FOR MATERNITY USE ONLY)

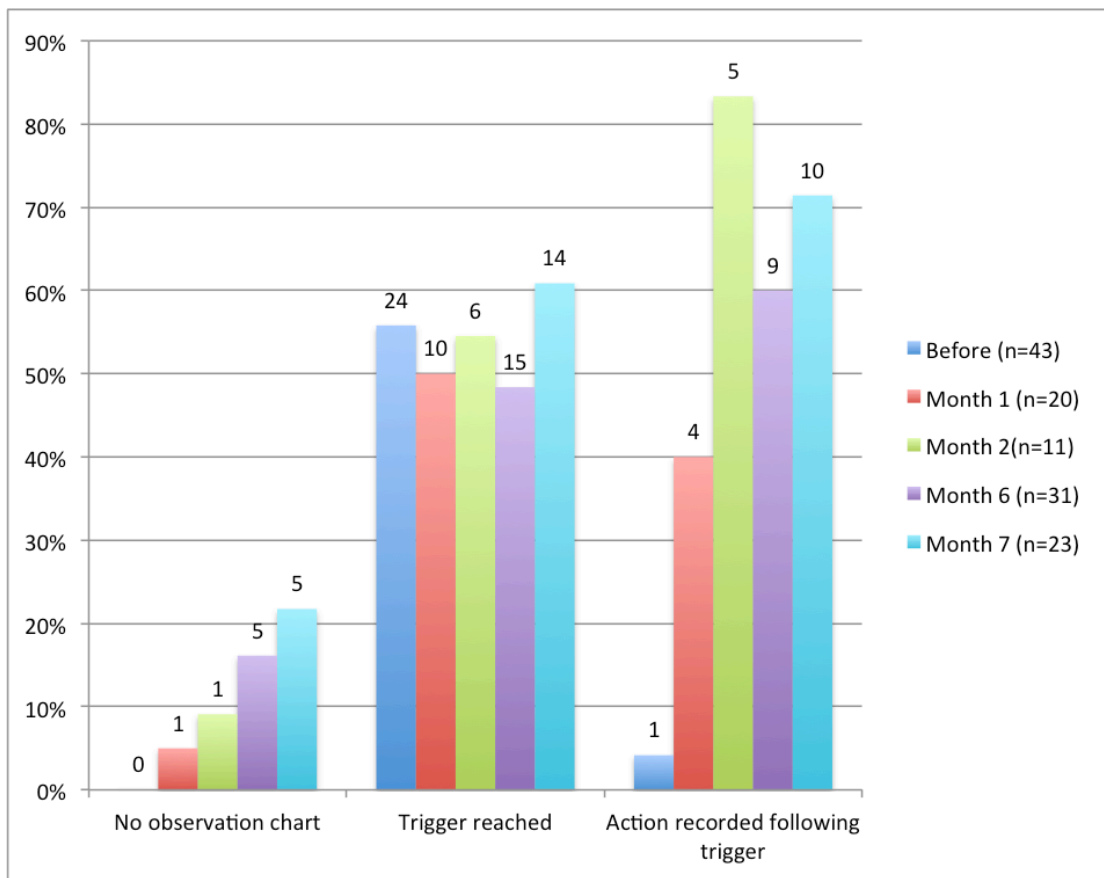
Frequency of observations

DATE	TIME	FREQUENCY	SIGNED	PRINT	STATUS	Name:
						DOR:
						Hospital No:
						Ward:

Date:							
Time:							
Respirations (write rate as range, box)	>30					>30	
	21-30					21-30	
	11-20					11-20	
	0-10					0-10	
Saturations if applicable:	95-100%					95-100%	
	<95%					<95%	
Temp	40					40	
	39					39	
	38					38	
	37					37	
	36					36	
	35					35	
Heart rate	170					170	
	160					160	
	150					150	
	140					140	
	130					130	
	120					120	
	110					110	
	100					100	
	90					90	
	80					80	
	70					70	
	60					60	
	50					50	
40					40		
Systolic blood pressure	200					200	
	190					190	
	180					180	
	170					170	
	160					160	
	150					150	
	140					140	
	130					130	
	120					120	
	110					110	
	100					100	
	90					90	
	80					80	
70					70		
60					60		
50					50		
Diastolic blood pressure	130					130	
	120					120	
	110					110	
	100					100	
	90					90	
	80					80	
	70					70	
	60					60	
	50					50	
	40					40	
	Urine Output	> 30mls/hr					> 30mls/hr
		< 30mls/hr or 1ml/hr					< 30mls/hr or 1ml/hr
Proteinuria	protein ++					protein ++	
	protein >+++					protein >+++	
Significant Oedema	No					No	
	YES					YES	
Amniotic fluid	Clear (C) Pink (P)					Clear (C) Pink (P)	
	Green (G)					Green (G)	
Fetal Heart Rate	>160					>160	
	110-159					110-159	
Neuro response (✓)	<100					<100	
	Alert					Alert	
	Voice					Voice	
	Pain					Pain	
PV loss	Unresponsive					Unresponsive	
	Normal (N)					Normal (N)	
Looks unwell	Mod (M) Severe (S)					Mod (M) Severe (S)	
	Offensive (O)					Offensive (O)	
	NO					NO	
	YES					YES	
Total Amber Scores							
Total Red Scores							
Action Taken Yes / No							
Action or reason for no action							

CONTACT DOCTOR FOR EARLY INTERVENTION IF PATIENT TRIGGERS ONE RED OR TWO AMBER SCORES AT ANY ONE TIME

409 Figure 1: Graph to show the utilization and action on the MOEWS charts over
410 time.



411

412

413

414